

Claims

1. An apparatus (10) for calibrating measuring instruments, such as bore gauges and the like, and comprising means for supporting the apparatus and calibrating means having contact means for the respective ends of the measuring ends (15, 17) of the instrument to be calibrated, these means being, for each measuring end of the instrument to be calibrated, in the form of a first and a second contact surface (31, 33d); the apparatus being characterised in that it comprises at least one adapter element (50) on at least one of the contact surfaces of the calibrating apparatus, said adapter element being designed to receive and support a respective end of the measuring instrument by adjusting to its profile.
2. The apparatus (10) according to claim 1 or according to the preamble to claim 1, characterised in that the contact means comprise a fixed block (14) that supports a respective end (15) of the measuring instrument.
3. The apparatus (10) according to any of the foregoing claims or according to the preamble to claim 1, characterised in that the contact means comprise a mobile block (16) that supports the other end (17) of the measuring instrument.
4. The apparatus (10) according to any of the foregoing claims, characterised in that the blocks (14, 16) that mount the contact means are aligned in a substantially horizontal direction.
5. The apparatus (10) according to claim 3 or 4, characterised in that it comprises means for driving the mobile block.
6. The apparatus (10) according to claim 5, characterised in that the means for driving the mobile block comprise means for guiding the mobile block.
7. The apparatus (10) according to claim 6, characterised in that the means for guiding the mobile block comprise a guide rod (20, 21).
8. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises a fixed mounting block (22) opposite the fixed block (14).
9. The apparatus (10) according to any of the foregoing claims from 6 to 8, characterised in that the guide means extend

transversally between the fixed block (14) and an opposite fixed mounting block (22).

10. The apparatus (10) according to any of the foregoing claims from 5 to 9, characterised in that the means for driving the mobile block comprise means for feeding the mobile block.

11. The apparatus (10) according to claim 10, characterised in that the means for feeding the mobile block comprise a drive shaft (21) that is operatively connected to the mobile block (16).

12. The apparatus (10) according to claim 11, characterised in that the drive shaft (21) is rotatably mounted on the fixed end blocks (20, 22).

13. The apparatus (10) according to any of the foregoing claims or according to the preamble to claim 1, characterised in that means are provided for controlling the apparatus.

15. The apparatus (10) according to any of the foregoing claims or according to the preamble to claim 1, characterised in that means are provided for determining the calibration measurement.

16. The apparatus (10) according to claim 14 or 15, characterised in that the means for determining the calibration measurement comprise means for storing the position of the mobile block (16).

17. The apparatus (10) according to any of the foregoing claims from 14 to 16, characterised in that the detecting means comprise sensor means on the mobile block (16).

18. The apparatus (10) according to any of the foregoing claims from 14 to 17, characterised in that the detecting means comprise a graduated reference rod.

19. The apparatus (10) according to claim 18, characterised in that the detecting means comprise a graduated rod positioned in front of the means for driving the mobile block (16).

20. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises means for connecting the adapter (50) to the block.

21. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises means for positioning the adapter (50) on the respective mounting block.
22. The apparatus (10) according to claim 20 or 21, characterised in that the connecting means are used to connect the adapter (50) to the fixed block.
23. The apparatus (10) according to any of the foregoing claims from 20 to 22, characterised in that the means for connecting the adapter (50) comprise holes (53, 55) into which respective pins provided on the head of the apparatus are inserted.
24. The apparatus (10) according to claim 23, characterised in that the holes (53, 55) are made in a bottom surface (54) of the adapter element (50).
25. The apparatus (10) according to any of the foregoing claims from 20 to 25, characterised in that spring means are provided for pushing the adapter element (52) towards and against an opposite vertical surface (60) of the fixed block (14).
26. The apparatus (10) according to claim 25, characterised in that the spring pushing means comprise springs (61, 63'), each supporting a respective insertion pin and being oriented vertically and being housed in respective vertical holes (62, 64) made in the fixed block (14).
27. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (52) comprises a groove (63) which forms a passage for the end (15) of the measuring instrument which extends towards and against a contact surface.
28. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (52) comprises a first and a second lateral surface (71, 73) abutting against the shaped end (15) of the measuring instrument (11).
29. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (52) comprises a rear or perpendicular surface abutting against the shaped end (15) of the measuring instrument (11).
30. The apparatus (10) according to claim 29, characterised in that the rear abutting surface for the shaped end (15) of the

measuring instrument (11) is provided by a rear surface (75) of the adapter having a defined thickness.

31. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (52) comprises a bottom surface (65) supporting the shaped end (15) of the measuring instrument (11).

5 32. The apparatus (10) according to claim 31, characterised in that the bottom surface (65) for supporting the shaped end (15) of the measuring instrument (11) comprises a first and a second 10 inwardly converging inclined part (67, 69).

33. The apparatus (10) according to claim 31 or 32, characterised in that the adapter element (152) comprises a flat bottom surface (165) for supporting said end.

15 34. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (152) comprises a first and a second bottom seat (180, 182) for accommodating a respective lateral portion of the shaped end (15) of the measuring instrument (11).

20 35. The apparatus (10) according to any of the foregoing claims from 31 to 34, characterised in that the adapter element (252) comprises a bottom forwardly inclined surface (265) supporting the shaped end (15) of the measuring instrument (11).

36. The apparatus (10) according to any of the foregoing claims 25 from 31 to 35, characterised in that the adapter element (352) comprises an upwardly curved bottom surface (365) supporting the shaped end (15) of the measuring instrument (11).

37. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (550) comprises a thick 30 bottom surface (567).

38. The apparatus (10) according to any of the foregoing claims from 27 to 37, characterised in that the adapter element (550) comprises a substantially triangular groove (563), with downwardly converging surfaces, for the passage of the end of the measuring instrument to be calibrated.

35 39. The apparatus (10) according to any of the foregoing claims, characterised in that the adapter element (50) comprises rear

longitudinal guide walls (79a, 79b) for the insertion of opposite lateral faces of the portion (31a) which bears the contact surface (31).

40. The apparatus (10) according to any of the foregoing claims or according to the preamble to claim 1, characterised in that mobile means are provided for closing a groove (13') in the frame cover of the apparatus.

41. The apparatus (10) according to claim 40, characterised in that the means for closing the groove (13') in the frame consist 10 of a flexible strip or tape (23).

42. The apparatus (10) according to any of the foregoing claims or according to the preamble to claim 1, characterised in that it comprises means for supporting a measuring instrument, said supporting means having at least one portion that is mobile 15 between a position where the instrument is supported and a retracted position.

43. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, characterised in that it comprises means for supporting long measuring instruments 20 extending between the first and the second contact surface, said intermediate supporting means having at least one portion that is mobile between a position where the instrument is supported and a retracted position.

44. The apparatus according to any of the foregoing claims or 25 according to the preamble to claim 1, characterised in that it comprises means for supporting long measuring instruments extending between the first and the second contact surface, said intermediate supporting means being permanently fixed to the apparatus mounting means.

45. The apparatus according to any of the foregoing claims from 30 42 to 44, characterised in that the retracted position of the intermediate supporting means is a rest position.

46. The apparatus according to any of the foregoing claims or 35 according to the preamble to claim 1, characterised in that the contact means for respective ends of the measuring instrument to be calibrated comprise a first and a second contact surface, which

move relative to each other, for a respective end of the instrument to be calibrated.

47. The apparatus according to any of the foregoing claims, characterised in that the fixed block (014) comprises an abutting member (0140) rigidly fixed to the base (012).

48. The apparatus according to claim 47, characterised in that the abutting member (0140) has a portal frame structure.

49. The apparatus according to claim 47 or 48, characterised in that the fixed block (014) has opposite longitudinal extensions (01405, 01406) with respective holes (01405', 01405", 01406', 01406", 01407', 01408') through which respective screws are inserted into the base of the apparatus.

50. The apparatus according to any of the foregoing claims from 47 to 49, characterised in that the fixed block (014) comprises a contact element (031) mounting body or block (0141) that is fitted in and retained by a long cavity (0142) made in the top of the abutting member (0140).

51. The apparatus according to any of the foregoing claims, characterised in that the supporting block (014) is equipped with plates (0148, 0149) forming respective front surfaces (0150, 0151) for engaging the rear surface of suitable adapter means.

52. The apparatus according to any of the foregoing claims, characterised in that the side walls (0146, 0147) constitute longitudinal lateral surfaces (0146a, 0147a) for guiding and centring respective surfaces of the adapter.

53. The apparatus according to any of the foregoing claims, characterised in that it comprises means (T1, T2) for locking the adapter in the working position.

54. The apparatus according to claim 53, characterised in that the locking means (T1, T2) are provided on the fixed block (014).

55. The apparatus according to claim 53 or 54, characterised in that the locking means (T1, T2) engage the back of a respective adapter.

56. The apparatus according to any of the foregoing claims from 53 to 55, characterised in that the locking means (T1, T2) exert a pulling action on the adapter.

57. The apparatus according to any of the foregoing claims from 53 to 56, characterised in that the locking means (T1, T2) extend in a direction perpendicular to the retaining means (056, 058).

58. The apparatus according to any of the foregoing claims from 5 53 to 57, characterised in that the locking means (T1, T2) can be actuated from the rear face (0140b, 0140c) of the abutting member (0140).

59. The apparatus according to any of the foregoing claims from 10 53 to 58, characterised in that the locking means comprise at least one horizontal through hole (0144a, 0144b) extending between respective rear faces (0140b, 0140c) and front faces (0150, 0151) of the abutting member (0140); the through hole (0144a, 0144b) being designed to receive a respective screw (T1, T2) for fastening the adapter.

15 60. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, characterised in that it comprises a mobile block (016) comprising a transversally mobile abutting member (0160) and a contact element (033) mounting body or block (0161) that is fitted in and retained by a long cavity (0162) in the abutting member (0160).

20 61. The apparatus according to claim 60, characterised in that means (0163, 0165) are provided for holding the block (0161) to the bottom mobile block (0160).

25 62. The apparatus according to any of the foregoing claims from 19 to 61, characterised in that the detecting means (025) lie in a substantially vertical plane.

63. The apparatus according to any of the foregoing claims from 10 to 62, characterised in that the means (021) for actuating the mobile block are parallel with and spaced from the guide rod (020).

30 64. The apparatus according to any of the foregoing claims from 10 to 63, characterised in that the means (021) for actuating the mobile block are parallel, and aligned substantially vertically, with a rod that supports the measuring rule.

35 65. The apparatus according to any of the foregoing claims, characterised in that means are provided for transmitting motion

to the means (023) that close the groove (013') in the frame cover of the apparatus, these means being mounted on the mobile block.

66. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises an adapter element (050) 5 consisting of a single body that defines a respective contact surface for a respective end of a measuring instrument to be calibrated.

67. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises an adapter element (050) 10 consisting of a single body that comprises a first and a second contact surface (053a, 055a) for a respective end of a measuring instrument to be calibrated.

68. The apparatus (10) according to any of the foregoing claims, characterised in that it comprises an adapter element (050) that 15 makes it possible to obtain an apparatus with a plurality of contact surfaces for measuring instrument sensing ends (015a, 015b, 015c) positioned at angular intervals of 120° from each other.

69. The apparatus (10) according to claim 68, characterised in 20 that the adapter element (050) comprises an abutting member (052) constituting means for supporting a first and a second sensing end (015a) and (015b) of the measuring instrument (011), while the other sensing end (015c) simply abuts against the mobile contact surface (033).

70. The apparatus according to any of the foregoing claims from 25 66 to 69, characterised in that the adapter element (050) comprises at least one vertical surface abutting against a respective end of a measuring instrument.

71. The apparatus according to any of the foregoing claims from 30 66 to 70, characterised in that the adapter element (050) comprises at least one bottom surface (065) for supporting the shaped end (015a) of the measuring instrument (011a).

72. The apparatus according to any of the foregoing claims, characterised in that it comprises an adapter (0150) that is 35 adjustable in height.

73. The apparatus according to claim 72, characterised in that it comprises an adapter (0150) consisting of a first element (0151)

having a fixed bottom portion (0152) that supports a top portion (0153) that is vertically mobile in order to adjust the height of the supporting portion of the instrument to the different lengths of the measuring instrument.

5 74. The apparatus according to claim 73, characterised in that the mobile top portion (0153) has a forked portion (0154) with a first and a second substantially horizontal leg (0154a, 0154b) forming a gap for the passage of the stem (011'b) of the measuring instrument (011b) towards the calibrating area.

10 75. The apparatus according to any of the foregoing claims, characterised in that the adapter (150) comprises an annular element (0160) constituting an abutting member for supporting the measuring instrument.

15 76. The apparatus according to claim 75, characterised in that the abutting member (0160) of the measuring instrument comprises a through hole (0161) that is adjustable in diameter.

77. The apparatus according to any of the foregoing claims, characterised in that the adapter means (0250) comprise a first adapter element (0251) associable with the contact surface (031) 20 on the fixed head, and a second adapter element (0252), associable with the contact surface (033) on the mobile head.

78. The apparatus according to any of the foregoing claims, characterised in that the adapter element (0251) comprises a top surface (0253) with a central hole (0254) providing a passage for 25 the contact means supporting elements.

79. The apparatus according to any of the foregoing claims, characterised in that the first adapter element (0251) comprises a longitudinal channel (0254) that extends on both the front and back of the contact element.

30 80. The apparatus according to claims 77 to 79, characterised in that the second adapter element (0252) of this assembly has a central hole (0264) providing a passage for the contact surfaces and for its supporting elements.

81. The apparatus according to any of the foregoing claims from 35 77 to 80, characterised in that the second adapter element (0252) has a top surface (0263) forming a central, longitudinal channel

(0264), having a front or downstream part (0264b) and a rear or upstream part (0264a).

82. The apparatus according to any of the foregoing claims, characterised in that the adapter element (0251) comprises a portion for guiding the respective sensing end of the measuring instrument, this portion comprises a groove (0352) located behind the contact means.

83. The apparatus according to any of the foregoing claims, characterised in that the adapter element (0351) comprises a pair of parallel longitudinal elements (0356, 0357) that support the guide plate and are located in front of the contact element.

84. The apparatus according to any of the foregoing claims from 77 to 83, characterised in that a second adapter element (0352), associated with the mobile head (016), forms a triangular or dovetail groove (0362) constituting an abutting portion for a sensing end of a measuring instrument.

85. The apparatus according to any of the foregoing claims, characterised in that the adapter (0450) consists of a single hollow body with a hole (0452) at the top of it for the passage of the bottom end of the measuring instrument (011e).

86. The apparatus according to any of the foregoing claims, characterised in that the adapter (0450) has a bottom (0455) having a hole (0457) for receiving the lower end of respective measuring instrument.

87. The apparatus according to any of the foregoing claims, characterised in that the adapter element (0450) has a front opening for the passage of the mobile contact element.

88. The apparatus according to any of the foregoing claims, characterised in that the adapter element (0450) comprises a rear opening (0459) for insertion towards the end of the instrument abutting against the contact surface (031) on the fixed head (014).

89. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, characterised in that the base plate (612) also mounts pre-recording means for a tool of a machine tool.

90. The apparatus according to claim 89, characterised in that the tool pre-recording means comprise a mobile target (617) and a fixed seat (621) for accommodating the tool.

5 91. The apparatus according to claim 89 or 90, characterised in that it comprises a single mobile body (615) that mounts both the pre-recording target (617) and the calibrating contact element (633).

10 92. The apparatus according to any of the foregoing claims from 89 to 91, characterised in that the fixed head (614) for the contact element (631) for calibrating a measuring instrument is provided at the end opposite the seat (621) for pre-recording the tool.

15 93. A method for calibrating measuring instruments, said method being characterised in that it comprises a step of setting the calibration measurement to a value equal to the real calibration measurement plus an additional length calculated as the mean tolerance allowed for that calibration measurement.

94. An adapter for at least one end of a measuring instrument, characterised in that it is made according to any of the foregoing 20 claims.